Effect of salt on energy transport in MOR hydrothermal systems

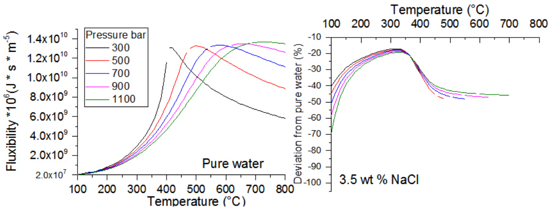
KLYUKIN, YU. I.[1*], LOWELL, R. P.[1] AND BODNAR, R. J.[1]

[1]Virginia Tech, Blacksburg, VA 24061, USA
(*correspondence: yury84@vt.edu)

Many studies of hydrothermal processes occurring at Mid-Ocean Ridges (MOR) are based on properties of pure H_2O [1]. However, it is well known that fluids in MOR systems are saline, and may differ from seawater salinity as result of phase separation. Adding salt to H_2O significantly affects the physical and thermodynamic properties of the fluid, especially at PT conditions in the critical region.

To examine the effect of adding salt (NaCl) to H_2O on energy transport in MOR systems, the scaled vertical energy flux (fluxibility) was estimated for H_2O-NaCl fluid and compared to pure H_2O. For a given PT and salinity, the fluxibility of H_2O-NaCl fluids was estimated according to the model of Jupp and Schultz (1), using density and enthalpy values from the SoWat model [2,3], and dynamic viscosity from [4]. Standard reference density and enthalpy at seabottom conditions of 4°C, 2.5 km depth (250 bars), 3.5 wt. % NaCl were calculated using the SoWat model.

The maximum fluxibility for pure H_2O occurs along the critical isochore and decreases as density increases or decreases (Fig. 1). Moreover, the change in fluxibility of the liquid phase is more senstive to changes in T in the vicinity of the critical isochore than vapor phase. For H_2O-NaCl fluids, the maximum fluxibility occurs near the two-phase boundary. Compared to pure H_2O, the fluxibility of seawater is ~20% lower at ~350° at any P, and the minimum difference in fluxibility of seawater (3.5 wt.% NaCl) compared to H_2O occurs at ~350°C and does not vary with pressure (Fig. 1). In the T range applicable to many MOR hydrothermal systems, the ability of a fluid of seawater salinity to transport thermal energy is ~20-40% less than that of pure H_2O (Fig. 1).



[1] Jupp & Schultz (2004) *J. Geophys. Res.* **109**, B05101. [2] Dreisner & Heinrich (2007) *Geochim. Cosmochim. Ac.* **71,** 4880-4901. [3] Dreisner (2007) *Geochim. Cosmochim. Ac.* **71,** 4902-4919. [4] Palliser & McKibbin (1998) *Transport. Porous. Med.* **33** 155-171.